DRAFT

Corrective Action Decision

Armco - Topeka Site
Topeka, Kansas

DRAFT: August 28, 2013

Kansas Department of Health and Environment
Environmental Remediation

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ACRONYMS AND ABBREVIATIONS USED IN THIS DOCUMENT

ARARs	Applicable or Relevant and Appropriate Requirements
AS	Air Sparge
AST	Above Ground Storage Tank
BER	Bureau of Environmental Remediation
bgs	Below Ground Surface
BNSF	Burlington Northern Santa Fe Railway Company
CAD	Corrective Action Decision
CAS	Corrective Action Study
CI	Comprehensive Investigation
COC	Contaminants of Concern
DHC	Dehalococcoides
DO	Dissolved Oxygen
EAB	Enhanced Anaerobic Bioremediation
Eh	Oxidation Reduction potential
EPA	United States Environmental Protection Agency
ERD	Enhanced Reductive Dechlorination
ERH	Electrical Resistive Heating
EUC	Environmental Use Control
IM	Interim Measure
ISCO	In-Situ Chemical Oxidation
KDHE	Kansas Department of Health and Environment
LTM	Long Term Monitoring
MCL	Maximum Contaminant Level
Mg/kg	milligrams per kilogram
NPL	National Priorities List
O&M	Operations and Maintenance
PCE	Tetrachloroethene
PRP	Potentially Responsible Party
RA	Remedial Action
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
ROI	Radius of Influence
RSK	Risk-Based Standards for Kansas
Shaw	Shaw Environmental, Inc.
SVOC	Semi-volatile Organic Compound
SVE	Soil Vapor Extraction
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency
VFA	Volatile Fatty Acid
VOC	Volatile Organic Compound
µg/L	micrograms per Liter

GLOSSARY

Administrative Record – The body of documents that form the basis for selection of a particular response at a site. Parts of the AR are available in an information repository near the site to permit interested individuals to review the documents and to allow meaningful participation in the remedy selection process.

Air Stripping – The process of forcing air through polluted water to remove harmful chemicals. The air causes the chemicals to change from a liquid to a gas. The gas is collected and treated if necessary.

Aquifer – An underground layer of rock, sand, or gravel capable of storing water within cracks and pore spaces or between grains. When water contained within an aquifer is of sufficient quantity and quality, it can be used for drinking or other purposes. The water contained in the aquifer is called groundwater.

Applicable or Relevant and Appropriate Requirements (ARARs) – The federal and state environmental laws that a remedy will meet. These requirements may vary among sites and alternatives.

Capital Costs – Expenses associated with the initial construction of a project.

Comprehensive Investigation (CI) – A study of the source, nature and extent of contamination.

Corrective Action Decision (CAD) – The decision document in which KDHE selects the remedy and explains the basis for selection for a site.

Corrective Action Study (CAS) – A study conducted to evaluate alternatives for clean-up of contamination.

Enhanced Anaerobic Bioremediation (EAB) – the process of allowing anaerobic microbes to clean up contaminants enhanced by adding nutrients.

Exposure - Contact made between a chemical, physical, or biological agent and the outer boundary of an organism. Exposure is quantified as the amount of an agent available at the exchange boundaries of the organism (e.g., skin, lungs, gut).

Groundwater – Underground water that fills pores in soils or openings in rocks to the point of saturation. Groundwater is often used as a source of drinking water via municipal or domestic wells.

Maximum Contaminant Levels (MCLs) – The maximum permissible level of a

contaminant in water that is delivered to any user of a public water system.

Monitoring – Ongoing collection of information about the environment that helps gauge the effectiveness of a cleanup action. For example, monitoring wells drilled to different depths at the Site would be used to detect any migration of the plume.

National Pollution Discharge Elimination System (NPDES) - As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches.

Operations and Maintenance (O&M) – Activities conducted at a site after the construction phase to ensure that the cleanup continues to be effective.

Plume – A body of contaminated groundwater flowing from a specific source.

Risk - The probability of adverse health effects resulting from exposure to an environmental agent or mixture of agents.

Tier 2 Level – Calculated risk-based cleanup value for a specific contaminant. These values can be found in Appendix A of the *Risk-Based Standards for Kansas (RSK) Manual*.

Threshold - The dose or exposure below which no harmful effect is expected to occur.

Toxicity – A measure of degree to which a substance is harmful to human and animal life.

Vapor Intrusion – The migration of contaminants from the subsurface into overlying and/or adjacent buildings.

Volatile Organic Compounds (VOCs) – Carbon compounds, such as solvents, which readily volatilize at room temperature and atmospheric pressure. Most are not readily dissolved in water, but their solubility is above health-based standards for potable use. Some VOCs can cause cancer.

Underground Injection Control (UIC) - Underground injection is the technology of placing fluids underground, in porous formations of rocks, through wells or other similar conveyance systems. While rocks such as sandstone, shale, and limestone appear to be solid, they can contain significant voids or pores that allow water and other fluids to fill and move through them. Man-made or

produced fluids (liquids, gases or slurries) can move into the pores of rocks by the use of pumps or by gravity. The fluids may be water, wastewater or water mixed with chemicals.

1. PURPOSE OF THE DRAFT CORRECTIVE ACTION DECISION

The primary purposes of the draft Corrective Action Decision (CAD) for the Armco-Topeka (Armco) Site (Site) are to: 1) summarize information from the key site documents including the Comprehensive Investigation (CI)[1] and Corrective Action Study (CAS)[2] reports; 2) briefly describe the alternatives for remediation detailed in the CAS report; 3) identify and describe the Kansas Department of Health and Environment's (KDHE) preferred remedy for addressing contamination at the Site; and, 4) provide an opportunity for public comment on the preferred remedy.

KDHE will select a final remedy for the Site after reviewing and considering all information submitted during the 30-day public comment period. KDHE may modify the preferred alternative based on new information or public comments; therefore, the public is encouraged to review and comment on the preferred remedy presented in this draft CAD. KDHE may hold a public availability session and/or a public hearing during the public comment period to present information regarding the preferred remedy and solicit public participation. The public may submit written comments to KDHE during the public comment period September 9, 2013 through October 9, 2013. Section 9.0 provides more information on the procedures for providing comments on the draft CAD.

Highlight 1-1: Public Information

Administrative Record File

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Bureau of Environmental Remediation
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Topeka, Kansas 66612-1367
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Shaw Environmental, Inc. performed the CI and CAS for the Armco Site on behalf of the AK Steel Corporation (AK Steel) in general accord with the Consent Order Case No. 4-E-0032, dated June 29, 2004. The public is encouraged to review and comment on the technical information presented in the CI and CAS reports and other documents contained in the Administrative Record file. The Administrative Record file includes all pertinent documents and site information that form the basis and rationale for selecting the final remedy. The Administrative Record file is available for public review during normal business hours at the location shown in Highlight 1-1.

[1] Shaw Environmental, Inc. 2007. *Comprehensive Investigation Report; Contech Construction Products Facility, Topeka, Kansas*, prepared on behalf of AK Steel Corporation, approved April 2007.
[2] Shaw Environmental, Inc. 2012. *Corrective Action Study Report; Contech Engineered Solutions, LLC. Topeka, KS*, prepared on behalf of AK Steel Corporation, approved January 2013.

2. SITE BACKGROUND

2.1. Site Location

The Armco Site is located at 2707 Northeast Seward Avenue in Topeka, Kansas (Figure 1). The Site is situated in an area of industrial, light commercial and residential uses and includes manufacturing, maintenance, grain storage, and fabrication facilities. Currently, the Site is being used as a corrugated steel culvert pipe manufacturing/distribution facility.

2.2. Site History

Between the 1960s and 1978, Armco Inc. (Armco) purchased the current Site property from the Atchison, Topeka and Santa Fe Railway Company (ATSF), now Burlington Northern Santa Fe (BNSF) through multiple transactions. From approximately 1940s-1960s Reid Chemical Company (Reid) leased the property from ATSF and later, Armco (now known as AK Steel); during which, Reid reportedly stored and formulated chemicals in the eastern portion of the Site. Additionally, Reid allegedly disposed of chemicals in a lagoon located near the center of the Site. ATSF also operated and maintained an oil disposal lagoon along the southern Site boundary until the mid-1970s (former Santa Fe Lagoon) along with several Underground Storage Tanks (USTs). Between 1981 and 2007, several investigations of eight different potential source areas located at the Site were conducted to better evaluate the nature and extent of subsurface contamination attributable to the Armco Site (Figure 2).

Based on multiple potential source areas evaluated, the primary contaminants of concern (COCs) for the Armco Site include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. In June 2004, AK Steel (formerly Armco) and Contech Engineered Solutions, LLC (formerly Contech Construction Products, Inc.) entered into a Consent Order with KDHE to conduct a Comprehensive Investigation and Corrective Action Study (CI/CAS) for the Site. A source area excavation was completed as an interim remedial measure (IRM) near the former Reid disposal lagoon in 2008 and a soil vapor extraction system (SVE) was installed in spring 2010, to address residual VOC impacts. The Consent Order outlined the requirements for investigating and evaluating remedial alternatives for the Site.

3. COMPREHENSIVE INVESTIGATION

The CI process was conducted in several phases beginning in 2005 and ending in 2007 with KDHE's approval of the Comprehensive Investigation Report. Objectives of the CI, as stated in the Consent Order include:

- Adequately characterize all source areas by identifying the type and nature of source(s), the cause and estimated quantity of each release, and the status of each release (active or inactive).

- Determine the vertical and horizontal extent of the impacts in the study area and identify migration pathways.
- Adequately characterize the chemical and physical properties of the target chemicals, relative mobility and the persistence in the environment, and primary fate and transport mechanisms.
- Identify any human and environmental receptors affected by the impacted area.
- Generate a sufficient quantity of data to allow for the development of an initial list of both short- and long-term corrective action alternatives to be further evaluated during the CAS.

3.1. Hydrogeological Setting

The CI included assessment of the geology and hydrogeology for determining pathways of contaminant migration. The Site is situated in the Kansas River Valley on discontinuous, unconsolidated deposits of clay, silt, and gravel identified as the Newman Terrace. The Newman Terrace deposits overlie the Pennsylvanian Severy Shale to a maximum depth of 90 feet. Soil boring lithology suggests that the vadose zone consists of soil and sediments from ground surface to approximately 28 to 30 feet below ground surface (bgs). The average depth to water at the Site is 28 feet bgs. The groundwater flow within the unconsolidated deposits below the Site is, in general, to the east, northeast toward the Kansas River (Figure 3). The Site is located approximately one half mile southeast of the Kansas River and one quarter mile north of Shunganunga Creek. Surface water runoff is directed to a channel of Shunganunga Creek that crosses the northwest corner of the Site through a combination of storm drains and surface drainage. Most of the Site is covered in gravel and used for storage of finished materials associated with manufacturing operations.

3.2. Summary of Comprehensive Investigation Results

The CI identified contamination in soil and groundwater originating from two distinct areas at the Site: the former Reid Lagoon, and the former Reid Building. Specifically, soil and groundwater contaminated with acetone, 1,2,4-trimethylbenzene, naphthalene, trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-DCE, and vinyl chloride was identified in the abovementioned source areas. Arsenic was also detected in groundwater at the Site; however, based on the spatial distribution of detections, no source area for arsenic was identified at the Site. In addition, this issue was resolved with the installation of permanent monitoring wells, which reduced the turbidity in the samples. Table 1 summarizes the maximum concentrations for COCs in soil with comparisons to KDHE's respective Tier 2 levels at the former Reid Building source area. Table 2 provides a summary of the maximum concentrations of select COCs in soil before and after the 2008 excavation of the Reid Lagoon source area. Tables 3, 4, and 5 summarize groundwater concentrations of COCs in source area wells, proximal, and distal wells, respectively. A more comprehensive data summary is provided in the Final CI report.

Due to the absence of COCs detected above KDHE Tier 2 levels in soil and groundwater during the CI at the former Heating Oil UST area and former Diesel Fuel Spill area, these particular potential source areas were not evaluated in the CAS. Additionally, the former Santa Fe Lagoon and the former Gasoline and Diesel Fuel UST area were not evaluated during the CAS. Currently, BNSF, AK Steel and Contech are working towards finalizing an agreement to address the former Santa Fe Lagoon contamination. The former Gasoline and Diesel Fuel UST area was accepted into the KDHE Petroleum Storage Tank Release Trust Fund program and assigned a "closed" status in August 2011.

Current on-site and off-site groundwater concentration maps for VOCs may be found on Figures 6 and 7, respectively.

4. SOURCE ABATEMENT AND INTERIM MEASURE IMPLEMENTATION

Interim measures (IMs) are actions or activities taken to quickly prevent, mitigate, or remedy unacceptable risk(s) posed to human health and/or the environment by an actual or potential release of a hazardous substance, pollutant, or contaminant. IMs for soil have been implemented at the former Reid Lagoon and former Reid Building. The IM included the excavation of the former Reid Lagoon and the installation of a soil vapor extraction (SVE) system to address both the former Reid Lagoon and the former Reid Building. Locations of the IMs are shown on Figure 4.

4.1. Soil Removal – 2008

In October 2008, during completion of the former Reid Lagoon IM, a total of 1,529 tons of contaminated soil was excavated to a depth of approximately 12 feet, and disposed of as non-hazardous waste at Rolling Meadows Landfill[3]. Soil samples were collected for VOC analysis during the completion of the IM; 10 samples were collected from the side walls of the excavation and five samples from the floor of the excavation and submitted for laboratory analysis. Sample results did not indicate COCs above respective RSK levels, with the exception of one floor sample that exceeded the residential RSK level for acetone. The excavation was then backfilled with clean material.

4.2. SVE System Installed – 2010

In January 2010, installation of the SVE system located near the former Reid Building was completed. SVE systems remove volatile chemicals from the soil by applying a vacuum through a network of underground wells. The system includes 8 deep, 12 intermediate, and 13 shallow

[3] Shaw Environmental, Inc., 2008, *Former Reid Lagoon Interim Remedial Measures Report.* Contech Construction Products Facility, Topeka, Kansas, Shaw Environmental, approved December 2008.

SVE wells[4]. Start-up of the deep and intermediate SVE system was conducted in March 2010 and the shallow system was placed on-line in June 2010. Maintenance of system operations are performed monthly to ensure system effectiveness and continued removal of COCs.

4.3. Pilot Studies

Remedial technology field pilot studies were performed as part of the CI to support the completion of the CAS at the Site. The information gained as a result of the pilot studies was used for evaluation and screening of remedial technologies as well as IM implementability.

- Bio-augmentation Testing: In order to determine if enhanced biodegradation is a viable alternative for treating contaminated groundwater, samples were collected and analyzed for microbial cultures, TCE degradation products, and other relevant constituents. Results from sampling indicate that natural degradation of contaminants is occurring at the Site. It is likely that enhanced bioremediation injections will speed up the rate of degradation of contaminants in groundwater.

- Soil Vapor Extraction Pilot Test: Data from these tests were evaluated to determine an estimated radius of influence (ROI), air flow, and effluent air concentrations to determine the feasibility of using SVE as a remedial alternative for the Site. Tests were also conducted in three zones; shallow, intermediate, and deep. The ROI during the shallow zone test was less than 10 feet, and the intermediate zone ranged from approximately 22-35 feet in the intermediate, and 55-60 feet in the deep. Based on the results of the test, SVE was implemented as an IM at the former Reid Building and former Reid Lagoon in March 2010.

5. SITE RISKS

The contaminants of concern for the Site are VOCs and metals in both soil and groundwater (hereinafter COCs).

The implementation of IMs has reduced the potential for exposure to contaminated soil at the Site. In addition, the Armco Site is a fenced facility, which limits access to the general public. The source areas are also capped with asphalt and compacted gravel, which significantly limits potential exposure to contaminated soil. Notwithstanding, soil impacts associated with the former Reid Lagoon and former Reid Building currently remain at the Site and still pose a potential risk. In particular, dermal, ingestion, and inhalation are potentially complete pathways for construction workers; yet, for the general public and employees, these pathways are

[4] Shaw Environmental, Inc., 2009, *Former Reid Building Interim Remedial Measures Soil Vapor Extraction System Work Plan Design*, Contech Construction Products Facility, Topeka, Kansas, Shaw Environmental, approved April 2009.

incomplete due to the location of the source areas under asphalt, and restricted access. The SVE system is also currently addressing residual concentrations of VOC contaminants in soil.

A water well survey was conducted during the CI to determine potential receptors that may have been in contact with contaminated groundwater. Results from this survey did not identify any domestic or lawn and garden wells in the downgradient residential area. There are also no current drinking water wells installed at the Site. Potential ingestion or dermal contact with contaminated groundwater is unlikely. Currently, potable water is being supplied to area residences by the City of Topeka.

Generally, chlorinated solvents tend to sink in the water table as they get further away from a source. Multiple years of data has been collected and evaluated at the Site and the groundwater plume is well understood. As groundwater flows from the Site, the chlorinated solvent plume increases in depth to greater than 40 feet bgs. In particular, the current intervals of concern in the residential areas are 50 to 55 feet bgs. Due to the depth of solvents in the groundwater, volatilization of COCs in groundwater to indoor air was removed as a complete exposure pathway.

6. REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are media-specific goals for protecting human health and the environment. RAOs are developed through evaluation of *applicable and relevant and appropriate requirements* (ARARs) and *To Be Considered* (TBC) standards with consideration of the findings of the CI. Based on this information, the following RAOs were developed for the Site as presented below.

- Restore groundwater to its most beneficial use.
- Prevent migration of COCs from soils to groundwater that would result in groundwater impacts in excess of levels for most beneficial use.
- Reduce the on-site contaminant concentrations in soil to the KDHE residential Tier 2 levels as determined by KDHE; and,
- Prevent additional degradation of groundwater or further migration off-site.

6.1. Cleanup Levels

For groundwater remediation being conducted at sites with drinking water aquifers, federally promulgated maximum contaminant levels (MCLs) are used as the cleanup levels. Even though groundwater in the vicinity of the Site is not currently used for drinking purposes, it is a potential

source of drinking water in the future. Therefore, MCLs, where available, are the final remedial cleanup levels for the Site. For those constituents which federal MCLs have not been established for groundwater, KDHE's *Risk-Based Standards for Kansas (RSK)* Tier 2 Levels apply and are the final remedial cleanup levels for the Site. For soil, KDHE's RSK Tier 2 Levels are the final remedial cleanup levels for the Site.

KDHE has calculated RSK Tier 2 Levels for soil for the protection of human health and protection of groundwater. The RSK Tier 2 Levels and methods of calculation are identified in KDHE's *RSK Manual* (KDHE 2010). The CI identified isolated residual VOC soil impacts at the Site at concentrations above applicable Tier 2 Levels. Additionally, constituents in groundwater above Tier 2 Levels were identified both on- and off-site.

The conclusions of the CI, the formation of the RAOs, and the determination of MCLs as the cleanup levels for groundwater and Tier 2 Levels as the cleanup levels for soil provide the basis for selecting a preferred remedial alternative. As previously discussed in Section 3.2; Tables 1 through 5 summarize the MCLs and Tier 2 Levels for contaminants in soil and groundwater.

7. SUMMARY OF REMEDIAL ALTERNATIVES EVALUATED

Through the CAS process, individual remedial action alternatives were first evaluated with respect to their ability to satisfy the following criteria as specified in the *National Oil and Hazardous Substance Contingency Plan*[5] (NCP): overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity mobility and volume of contamination through treatment; short-term effectiveness; implementability; and, cost. The remedial action alternatives were then compared against one another to facilitate the identification of the preferred alternative. A detailed description of the various remedial action alternatives and the individual and comparative analysis is presented in the CAS report. Brief summaries of the remedial action alternatives, including the preferred remedial action alternative, are provided below.

The NCP requires the evaluation of a "No Action" alternative to serve as a baseline for comparison to other remedial action alternatives evaluated. The following remedial alternatives were evaluated based upon the findings of the CI/CAS.

With the exception of the "No Action" alternative, the following alternatives are listed under each impacted environmental media to which they apply. For clarification, several media specific alternatives were evaluated in the CAS and a combination of alternatives was identified as the preferred alternative. Alternatives 2 and 3 address source area soils. Source areas soils are defined as soils in the Reid Lagoon and Reid Building; Alternatives 4 and 5 address source area groundwater; and, Alternatives 6 and 7 address off-site groundwater.

[5] National Oil and Hazardous Substance Contingency Plan, 40 CFR 300 et seq.

7.1. No-Action

Alternative 1 – No-Action

For the purpose of the CAS, the "No Action" alternative included no additional investigation or remedial actions at the Site. The SVE system would be placed off-line and all activities, with the exception of monitoring, would cease. This alternative evaluates groundwater monitoring of all 42 monitoring wells on an annual basis for a period of 30 years. No further actions would be taken to reduce contaminant mass, address potential exposure pathways, or reduce the potential for contaminant migration. Since no remedial action is taken, risks to human health and the environment would not be addressed.

The present value cost of Alternative 1 is $241,205.

7.2. Source Area Soils

To evaluate the effectiveness of source area removal, long-term groundwater monitoring (LTM) is currently being conducted on a quarterly basis from eight shallow source area monitoring wells (PRG-7, MW-16S, MW-19S, MW-20S, MW-21S, MW-33S, MW-34S, and MW-35S); see Figure 5).

Both source area soil alternatives assume that the same eight monitoring wells, located in both source area locations, would continue to be monitored for an estimated five years until the Site meets reclassification criteria. However, evaluation of the data may dictate revisions to the monitoring network and/or frequency of the sampling in the future, as approved by KDHE. Groundwater would continue to be analyzed for COCs in the source area in order to evaluate treatment effectiveness.

Alternative 2 – Soil Excavation and SVE

Alternative 2 includes the excavation, disposal, and capping of shallow source areas at the former Reid Lagoon and the implementation of SVE at both the former Reid Lagoon and the former Reid Building. Both of these remedial actions were implemented as IMs at the Site, and the SVE system is currently on-line. Operation, Monitoring and Maintenance (OM&M) of the SVE system includes collection of air samples to determine VOC removal by each of the three zones within the system.

The total present value cost of Alternative 2 is $1,202,111. This value includes already expended capital costs for the excavation ($346,287) and SVE installation ($197,334). The balance of $658,490 will include present and future operational costs.

Alternative 3 – Electrical Resistive Heating (ERH) and SVE

Alternative 3 includes two remedial technologies to address VOC impacts to soil in the two abovementioned source areas. In this alternative, Electrical Resistive Heating (ERH) and SVE would be used to address soil concentrations through volatilization of VOCs. If selected as the preferred alternative, actual application would be based on pilot testing and final engineering development and design.

ERH uses electrodes to heat the subsurface while the resultant vapors are recovered under a vacuum. Heating the subsurface to a temperature of 100ºC results in a change to the thermodynamic properties of soil in the subsurface. As the temperature rises, the vaporization of VOCs increases. Soil vapors removed from the subsurface by ERH would be addressed by the SVE system, which is currently in place. ERH system installation activities would include procurement and mobilization of equipment, installation of electrodes, vapor recovery wells, temperature monitoring points; and, stainless steel monitoring wells to withstand increased soil temperature. The ERH system would likely need to operate for several months, during which, the system would be maintained and monitored by qualified technicians. Post-treatment, the subsurface would be allowed to cool to ambient temperature and the treatment system components removed and/or abandoned.

The present value cost of Alternative 3 is $3,358,236.

7.3. Source Area Groundwater

Both alternatives assume routine long-term monitoring of eight source area wells for VOCs, metals, and additional geochemical parameters.

Alternative 4 – Enhanced Bioremediation

This alternative includes enhanced bioremediation to address VOC impacts in groundwater in the area of the former Reid Building. Enhanced bioremediation utilizes the injection of natural or synthetic compounds to enhance in-situ biodegradation rates of contaminants located in the subsurface. The reduction of VOCs can be enhanced through biodegradation with the addition of a carbon source, bacteria, and nutrients. The process of breaking down chlorinated solvents to less harmful chemicals is known as reductive dechlorination. Based on the results of the

biodegradation pilot test and prior to implementing remedy, actual application would be based on pilot testing and final engineering development and design.

This alternative assumes three rounds of injections of carbon substrate and one injection of bacteria consortium would be injected to promote reductive chlorination. A 12-year time frame was estimated to attain RAOs for source area groundwater at the former Reid Building.

The present value cost of Alternative 4 is $555,181.

Alternative 5 – In-Situ Chemical Oxidation

This alternative includes in-situ chemical oxidation (ISCO) to address VOC impacts in groundwater in the area of the former Reid Building. ISCO involves the introduction of a chemical oxidant into the subsurface for the purpose of transforming groundwater or soil contaminants into less harmful chemical species. In particular, sodium permanganate ($NaMnO_4$) would be injected into the subsurface using direct-push techniques. ISCO destroys contaminants in the subsurface without having to pump the contaminated groundwater out of the ground for treatment. The oxidant mixes with the harmful chemicals and causes them to break down. When the process is complete, only water and other harmless chemicals are left behind. Prior to implementation, pilot scale testing would be conducted utilizing aquifer materials to establish oxidant demand for the media, soil and groundwater. An appropriate amount of injection points would be required to ensure coverage of the proposed area. Injections would be performed over multiple events to evaluate the effectiveness and possibly modify the percentage of sodium permanganate injected during subsequent events.

The present value cost of Alternative 5 is $2,266,244.

7.4. Non-Source Area Groundwater

Alternative 6 – Non-Source Area Enhanced Bioremediation and LTM

Alternative 6 includes the use of enhanced bioremediation to address VOCs in non-source area groundwater and Long Term Monitoring (LTM) to evaluate changes in the groundwater plume. This alternative includes the remedial technology presented in Alternative 4 (enhanced bioremediation) at non-point source areas with additional off-site groundwater monitoring. In particular, enhanced bioremediation injections would be initiated at the eastern property boundary of the Site, in areas where microorganism counts are lower in wells that are away from the source area. Actual application of this alternative would be based on pilot testing and the final engineering design.

For costing purposes, this alternative specifies the frequency of groundwater monitoring and performance evaluation sampling below. Please note that specific monitoring wells, analytes and

parameters, and frequency of sampling events will be indicated in the Corrective Action Plan (CAP) document to be approved by KDHE. Routine monitoring of eight proximal wells and nineteen distal wells would be conducted for 10 years. The proximal wells would be sampled for VOCs, RCRA metals, nitrates, sulfates, VFAs, and methane, ethane and ethene. Water quality parameters would also be recorded for ferrous iron, pH, DO, and ORP. Distal wells would be sampled for VOCs only. After the 10 years of monitoring, both the proximal and distal wells would be monitored for VOCs through the completion of the project. An annual water well survey would be conducted to determine if any new potable water wells have been installed in the area.

LTM consists of the collection of groundwater samples from an established monitoring well network and statistical analysis of contaminant concentrations over time to evaluate long term monitoring goals, identify data gaps in the monitoring data, and evaluate the effectiveness of the remedial action alternatives. A Monitoring Plan and Source Control Plan will be developed that include monitoring procedures and evaluation of the progress toward achieving the RAOs for the Site. A five year review will also be conducted to determine if implementation of additional remedial action is required to attain the RAOs. Additional bioremediation of the plume would be implemented downgradient of the Site to achieve the remediation goals as a contingency. Based on estimated velocities of groundwater, an additional 12 years of groundwater monitoring of the proximal and distal wells would be required. To account for variations in groundwater velocities across the Site, the estimated time to attain RAOs in non-source area groundwater using enhanced bioremediation is 25 years.

The present value cost of Alternative 4 is $615,110.

Alternative 7 – LTM and EUC

Alternative 7 incorporates LTM in order to evaluate changes to the groundwater plume resulting from the former Reid Building and Lagoon soil and groundwater remedies. Groundwater monitoring data would evaluate mass flux, plume stability, and concentration trends. Natural attenuation of the residual COCs relies on a suite of natural attenuation processes to reduce contaminant concentrations to acceptable levels. Based on bio-attenuation testing conducted at the Site, natural attenuation is occurring through the reduction of chlorinated compounds. LTM would be used in conjunction with selected remedial alternatives for soil and groundwater source areas. This alternative includes:

- Periodic sampling of groundwater to evaluate the effectiveness of remedial actions
- Evaluation of the reduction of COCs in the aquifer; and,
- Conducting an annual water well survey to determine if the installation of new water wells in the area has occurred.

To achieve RAOs, source area remediation and LTM in conjunction with the establishment of Environmental Use Control(s) (EUCs) will be implemented. The LTM would be implemented

consistent with Alternative 6. An annual water well survey would be conducted to determine if any new potable water wells have been installed in the area at a frequency presented in the CAP. Costs for implementation of Alternative 7 were based on groundwater monitoring for an estimated timeframe to achieve RAO's for the non-source area groundwater of 44 years.

The present value cost for Alternative 7 is $386,634.

8. DESCRIPTION OF THE PREFERRED REMEDY

After evaluation of the individual analysis of remedial action alternatives, a comparative analysis of the various alternatives was performed with consideration of the threshold and balancing criteria specified in the NCP. On the basis of information summarized above, KDHE has selected **Alternatives 2, 4, and 6**, as the preferred remedy for the Site. The results of the comparative analysis support the preferred remedy outlined below and presented in Table 6. The total present value cost of the preferred remedy is $2,372,402 as presented in Table 7. Locations of the treatment areas for the preferred alternative are included on Figures 8, 9 and 10. Elements of KDHE's preferred remedy are summarized by source area and media represented below:

8.1. Source Area Soil

Alternative 2, which includes soil excavation and SVE treatment of soil, is recommended as the remedial alternative for the former Reid Lagoon and former Reid Building areas. Additionally, SVE is used to facilitate the removal of VOCs from unsaturated soils by applying a vacuum to a network of wells. ERH would be implemented as a contingency, if the SVE system does not achieve RAOs in these areas. As previously discussed in Section 4.0, in October 2008 and January 2010, AK Steel implemented the KDHE approved IMs for soil including soil excavation and SVE. The soil excavation IM addresses contamination in respect to both short-term and the long-term contaminant reduction. This alternative also addresses the reduction of toxicity, mobility, and volume of constituents in soil directly. SVE wells are strategically placed to mitigate soil impacts in the former Reid Lagoon where residual concentrations remained post-excavation. The SVE system is currently operating and successful in reducing contaminant concentrations.

8.2. Source Area Groundwater

Alternative 4, enhanced bioremediation of groundwater is recommended as the remedial alternative for the former Reid Building area. As discussed in Section 7.4, this alternative consists of the injection of a carbon substrate through a network of wells to enhance or accelerate bioremediation processes. Enhanced biodegradation and bioaugmentation (the addition of bacteria) are proven remedial methods for groundwater aquifers contaminated with chlorinated VOCs. Complete dechlorination has been documented at the Site. Reductive dechlorination

relies on bacteria, in a reducing environment, to degrade harmful contaminants into harmless chemicals. The results of the pilot study indicated that in-situ enhanced bioremediation is an applicable and feasible treatment technology.

Routine monitoring and potential adjustment in pH and nutrients to maintain reliable operation are required. Depending on future monitoring data, ISCO will be implemented as a contingency if the bioremediation action does not achieve RAOs in this area. With consideration of identified contingencies, this alternative is protective of human health and the environment.

8.3. Non-Source Area Groundwater

Alternative 6, enhanced bioremediation and LTM of groundwater is selected as the preferred remedy for the off-site groundwater plume at the Armco Site. A groundwater treatment zone of approximately 20 feet would be implemented at the Armco Site property line. The time of remediation is estimated at 10 years, and the estimated time to attain RAOs for the Site is 25 years. LTM will consist of routine groundwater sampling and an annual water well survey to ensure no future drinking water wells are installed within the impacted groundwater plume.

The estimated remedial action time frame for Alternative 6 is significantly less than Alternative 7, which poses no active treatment for non-source groundwater. The contingency remedial action for off-site groundwater contamination consists of additional enhanced bioremediation in areas of the groundwater plume to attain RAOs.

9. COMMUNITY INVOLVEMENT

A Public Relations Strategy for the Site was developed by KDHE. Public input and comment has been encouraged by KDHE throughout the process. Public notice of the availability of the draft CAD will be published in the *Topeka Capitol Journal*. In addition, KDHE has established a webpage dedicated to the Armco Site, available online at www.kdheks.gov/remedial. Many site documents, including this draft CAD, are available on the webpage.

KDHE will select a final remedy after reviewing and considering all information submitted during the 30-day public comment period. KDHE may modify the preferred remedy based on new information or public comments. The public is encouraged to review and comment on the preferred remedy presented in this draft CAD. As per the Public Relations Strategy, KDHE may hold a public availability meeting during the public comment period to present information regarding the preferred remedy and solicit public participation. The Notice of the public meeting will also be published in the *Topeka Capitol Journal.*

The public may provide comments on the draft CAD during the 30-day public comment period. Public comments on the draft CAD may be submitted to KDHE during the public hearing or in writing during the 30-day public comment period. Written comments must be postmarked by October 9, 2013, and mailed to the name and address specified below:

Kansas Department of Health and Environment
Bureau of Environmental Remediation
1000 SW Jackson Street; Suite 410
Topeka, Kansas 66612-1367
Contact: Charlotte Philip
Phone: 785-296-0291

Comments on the draft CAD may also be submitted to KDHE by electronic mail to cphilip@kdheks.gov. Comments sent by electronic mail must be received by KDHE by 5:00 p.m. on October 9, 2013. All comments that are received by KDHE prior to the end of the public comment period will be addressed by KDHE in the Responsiveness Summary Section of the Final CAD.

Kansas Department of Health and Environment
Environmental Remediation

TABLES

Table 1 – Analytical Results Summary – Former Reid Building - Soil

Compound	Historical Maximum Concentration mg/kg	Soil KDHE Tier 2 Level‡ mg/kg	Soil-to-Groundwater KDHE Tier 2 Level‡ mg/kg
TCE	**2.7**	41	0.0842
Cis-1,2-DCE	**10**	115	0.855
PCE	0.022	0.121	7.54
Naphthalene	**0.490**	30.5	0.349

‡*KDHE Tier 2 Levels default to MCLs where available. Tier 2 Level for soil provided from KDHE's Risk Based Standards for Kansas (RSK) Manual, October, 2010.*

Table 2 – Analytical Results Summary – Former Reid Lagoon - Soil

Compound	Pre-Excavation Concentration mg/kg	Post-Excavation Concentration mg/kg	Soil KDHE Tier 2 Level‡ mg/kg	Soil-to-Groundwater KDHE Tier 2 Level‡ mg/kg
TCE	0.005	0.00072	41	0.0842
Cis-1,2-DCE	0.006	NS	115	0.855
PCE	0.006	0.00089	0.121	7.54
Naphthalene	**9.4**	NS	30.5	0.349
Acetone	**66**	**75.6**	50,300	51.6
1,2,4-trimethylbenzene	**3.6**	**1.41**	54	1.07

NS: Not Sampled

‡*KDHE Tier 2 Levels default to MCLs where available. Tier 2 Level for groundwater provided from KDHE's Risk Based Standards for Kansas (RSK) Manual, October, 2010.*

Table 3 – VOC Analytical Results Summary –

Source Area Wells – Groundwater

Well ID	Compound	Historical Maximum Concentration µg/L	Current Concentration (January 2013) µg/L	Groundwater MCL or KDHE Tier 2 Level‡ µg/L
MW-19S	TCE	**7,900** (Nov. 2009)	**782**	5
MW-19S	Cis-1,2-DCE	**31,000** (Jan. 2011)	**2,440**	70
MW-19S	PCE	**110** (July 2010)	**36.7**	0.5
MW-19S	1,1-DCE	**18.3** (Nov. 2009)	1.3	7
MW-19S	Vinyl Chloride	**95** (Oct. 2010)	1.4	2
MW-19S	Trans-1,2-DCE	**431** (Nov. 2009)	29.5	100

‡*KDHE Tier 2 Levels default to MCLs where available. Tier 2 Level for groundwater provided from KDHE's Risk Based Standards for Kansas (RSK) Manual, October, 2010.*

Table 4 – VOC Analytical Results Summary –

Proximal Wells – Groundwater

Well ID	Compound	Historical Maximum Concentration µg/L	Current Concentration (October 2012) µg/L	Groundwater MCL or KDHE Tier 2 Level‡ µg/L
MW-32I	TCE	**390** (Apr. 2011)	**279**	5
MW-32I	Cis-1,2-DCE	**590** (Apr. 2011)	**468**	70
MW-32I	Vinyl chloride	<10 (Oct. 2005)	**2.9**	2
MW-30S	PCE	**60** (Oct. 2010)	**44.5**	5

‡*KDHE Tier 2 Levels default to MCLs where available. Tier 2 Level for groundwater provided from KDHE's Risk Based Standards for Kansas (RSK) Manual, October, 2010.*

Table 5 – VOC Analytical Results Summary –

Distal Wells – Groundwater

Well ID	Compound	Current Concentration (April 2012) µg/L	Groundwater MCL or KDHE Tier 2 Level‡ µg/L
MW-26I	TCE	**140**	5
MW-26I	Cis-1,2-DCE	**130**	70
MW-27I	PCE	**8.2**	5
MW-37I	Arsenic	**30.9***	10

‡*KDHE Tier 2 Levels default to MCLs where available. Tier 2 Level for groundwater provided from KDHE's Risk Based Standards for Kansas (RSK) Manual, October, 2010.*
**Data collected in May 2008*

Table 6 – Summary of the Preferred Alternative

MEDIA OF INTEREST	Preferred Alternative	Area	Contingency
Soil	Alternative 2: Excavation and SVE	Former Reid Building Former Reid Lagoon	Electrical Resistive Heating
Source Area Groundwater	Alternative 4: Enhanced Bioremediation	Former Reid Building	In-Situ Chemical Oxidation
Off-Site Groundwater Plume	Alternative 6: Enhanced Bioremediation and LTM	Off-Site Groundwater Plume	Additional Enhanced Bioremediation

Table 7 – Estimated Cost of the Preferred Alternative

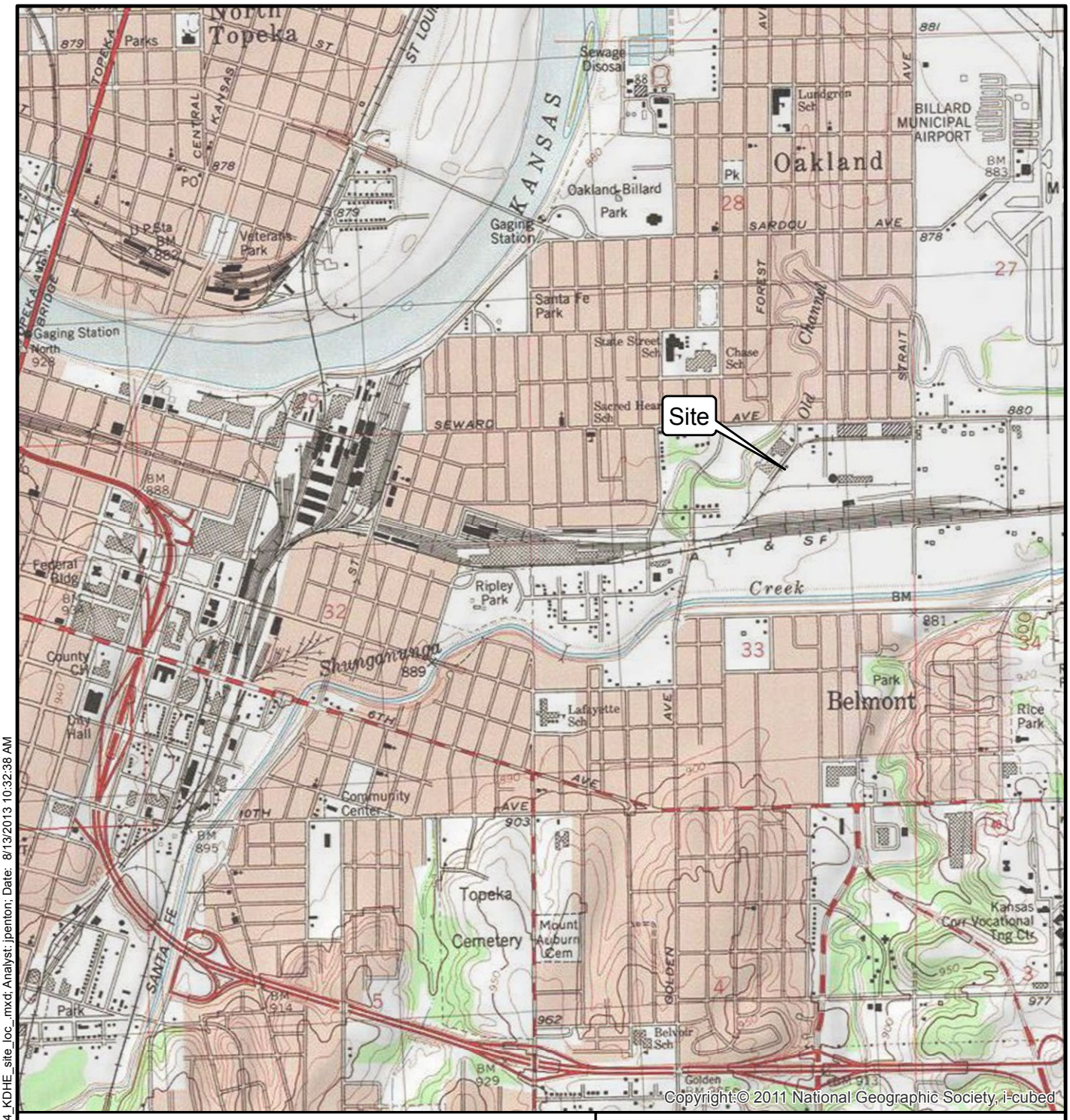
Groundwater Unit	Preferred Alternative	Total Capital Cost	Total O&M Cost	System Closure/Closure Sampling	Present Value Cost
Soil	Alternative 2: Excavation and SVE	$543,621	$600,591	$57,899	$1,202,111*
Source Area Groundwater	Alternative 4: Enhanced Bioremediation	$219,872	$332,800	$2,508	$555,181
Off-Site Groundwater Plume	Alternative 6: Enhanced Bioremediation and LTM	$307,905	$301,871	$5,335	$615,110
				***Total Estimated Present Value Cost*‡**	**$2,372,402**

‡*Cost projection provided in the Corrective Action Study Report (Shaw 2012)*

** Total includes cost already expended during interim measure implementation 2008-2010*

Kansas Department of Health and Environment
Environmental Remediation

FIGURES



N

0 2,000 4,000

Feet

SHAW ENVIRONMENTAL & INFRASTRUCTURE, INC.
(A CB&I COMPANY)
7330 W. 33RD STREET NORTH, SUITE 106
WICHITA, KANSAS 67205
(316) 220-8020

SITE LOCATION MAP

CLIENT: CONTECH - AK STEEL

LOCATION: TOPEKA, KANSAS

FIGURE: 1

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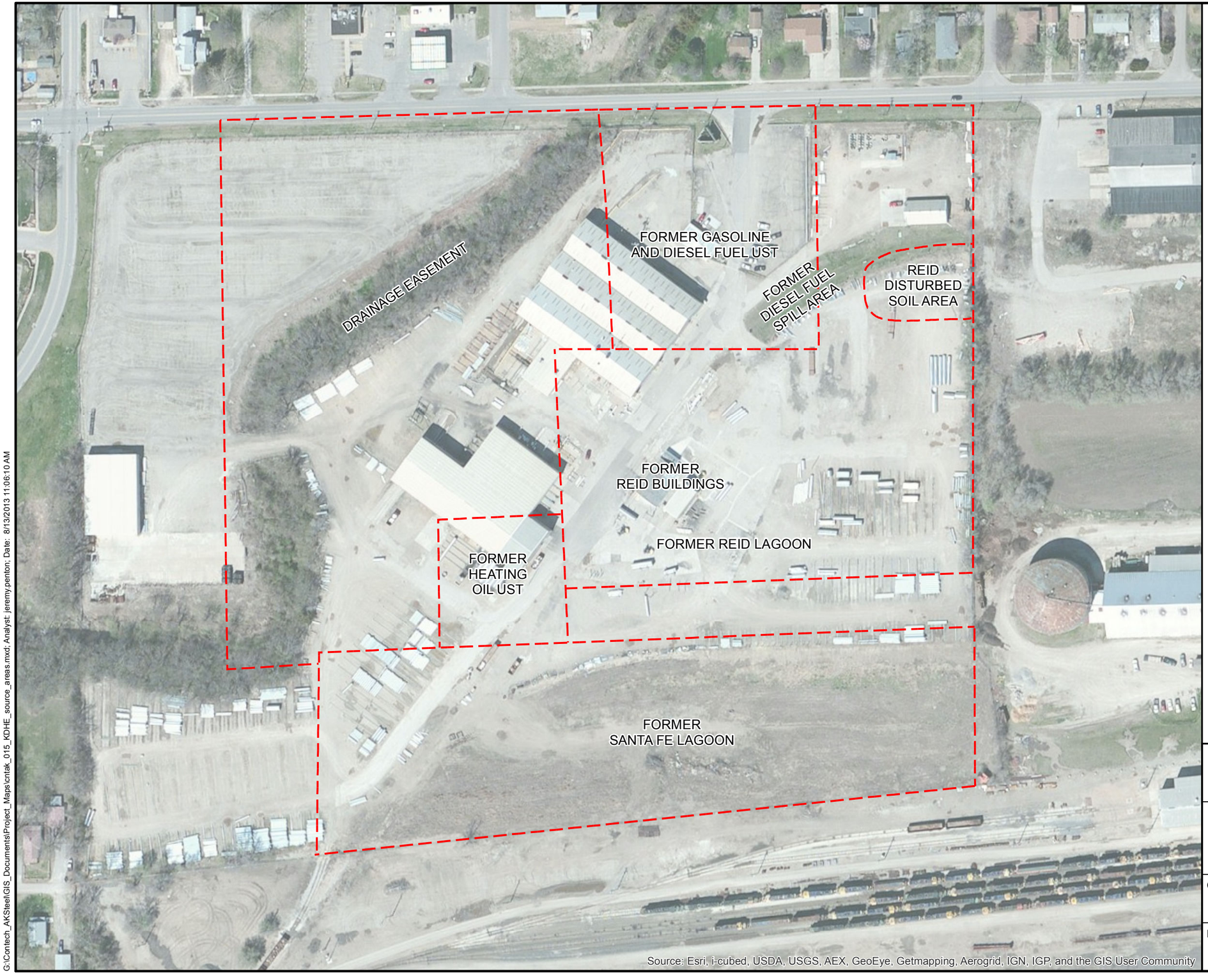

LEGEND

Boundary of Potential Areas of Concern

N

0 150 300

Feet

SHAW ENVIRONMENTAL, INC.
(A CB&I COMPANY)
7330 W. 33RD STREET NORTH, SUITE 106
WICHITA, KANSAS 67205
(316) 220-8020

LOCATION OF POTENTIAL SOURCE AREAS

CLIENT:
CONTECH - AK STEEL

LOCATION:
TOPEKA, KANSAS

FIGURE:
2

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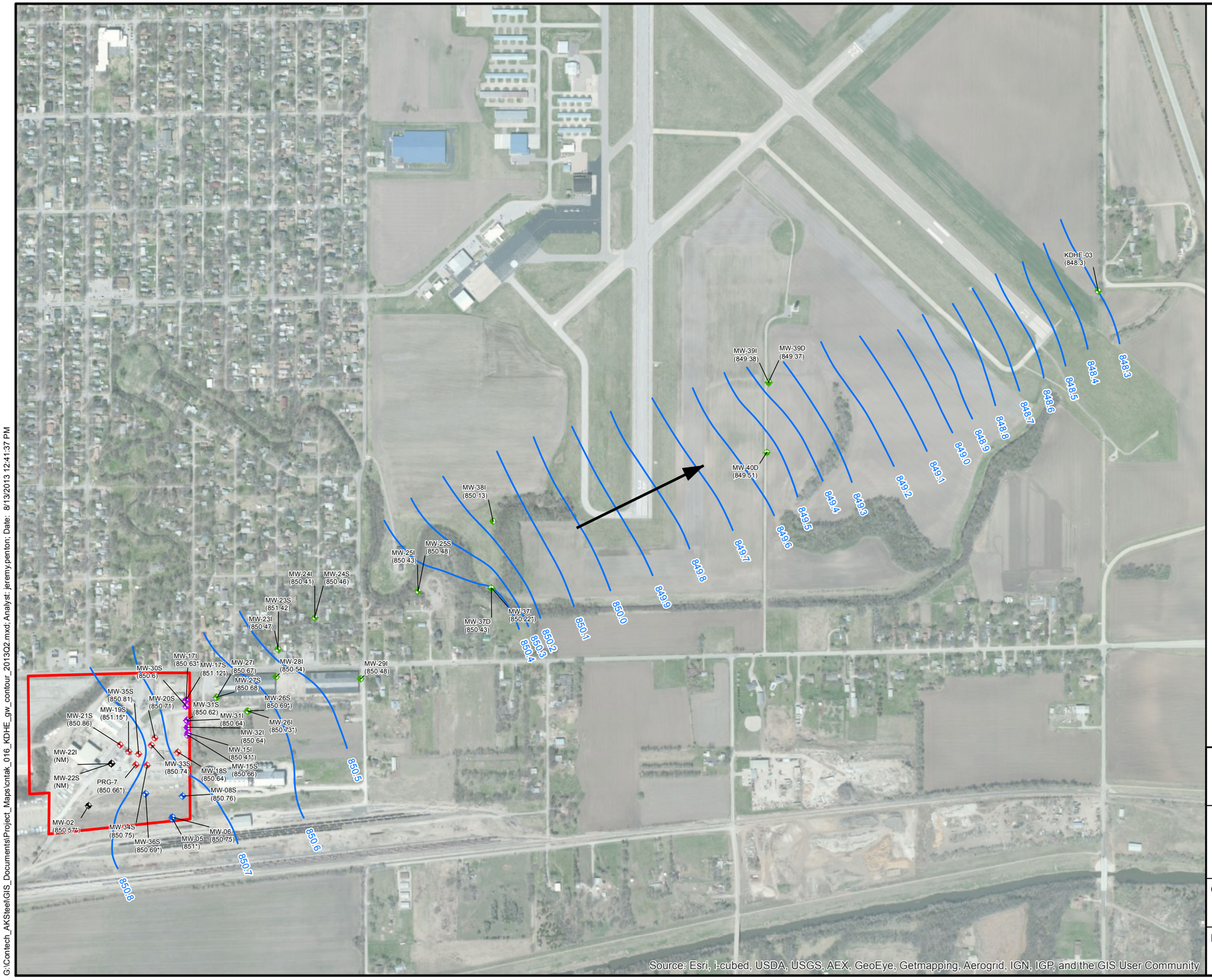

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LEGEND

Well Type

- Shallow, Distal Well
- Shallow, Non-Critical Well
- Shallow, Proximal Well
- Shallow, Source Area Well
- Intermediate, Non-Critical Well
- Intermediate, Proximal Well
- Intermediate, Distal Well
- Deep, Distal Well
- Site
- Groundwater Flow

(849.38) Groundwater Elevation (ft)

(850.22*) Posted Data Only - Not used in Contouring

Note: NM = Not Measured

N

0 700 1,400

Feet

SHAW ENVIRONMENTAL, INC.
(A CB&I COMPANY)
7330 W. 33RD STREET NORTH, SUITE 106
WICHITA, KANSAS 67205
(316) 220-8020

GROUNDWATER FLOW MAP APRIL 2013

CLIENT: CONTECH - AK STEEL

LOCATION: TOPEKA, KANSAS

FIGURE: 3

Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

LEGEND

- Deep SVE Well
- Intermediate SVE Well
- Shallow SVE Well
- Deep Vapor Extraction Well
- SVE Building
- Former Reid Lagoon (Removed 9/2008)
- SVE Piping

N

0 30 60

Feet

SHAW ENVIRONMENTAL, INC.
(A CB&I COMPANY)
7330 W. 33RD STREET NORTH, SUITE 106
WICHITA, KANSAS 67205
(316) 220-8020

LOCATION OF INTERIM MEASURES MARCH 2010

CLIENT: CONTECH - AK STEEL

LOCATION: TOPEKA, KANSAS

FIGURE: 4

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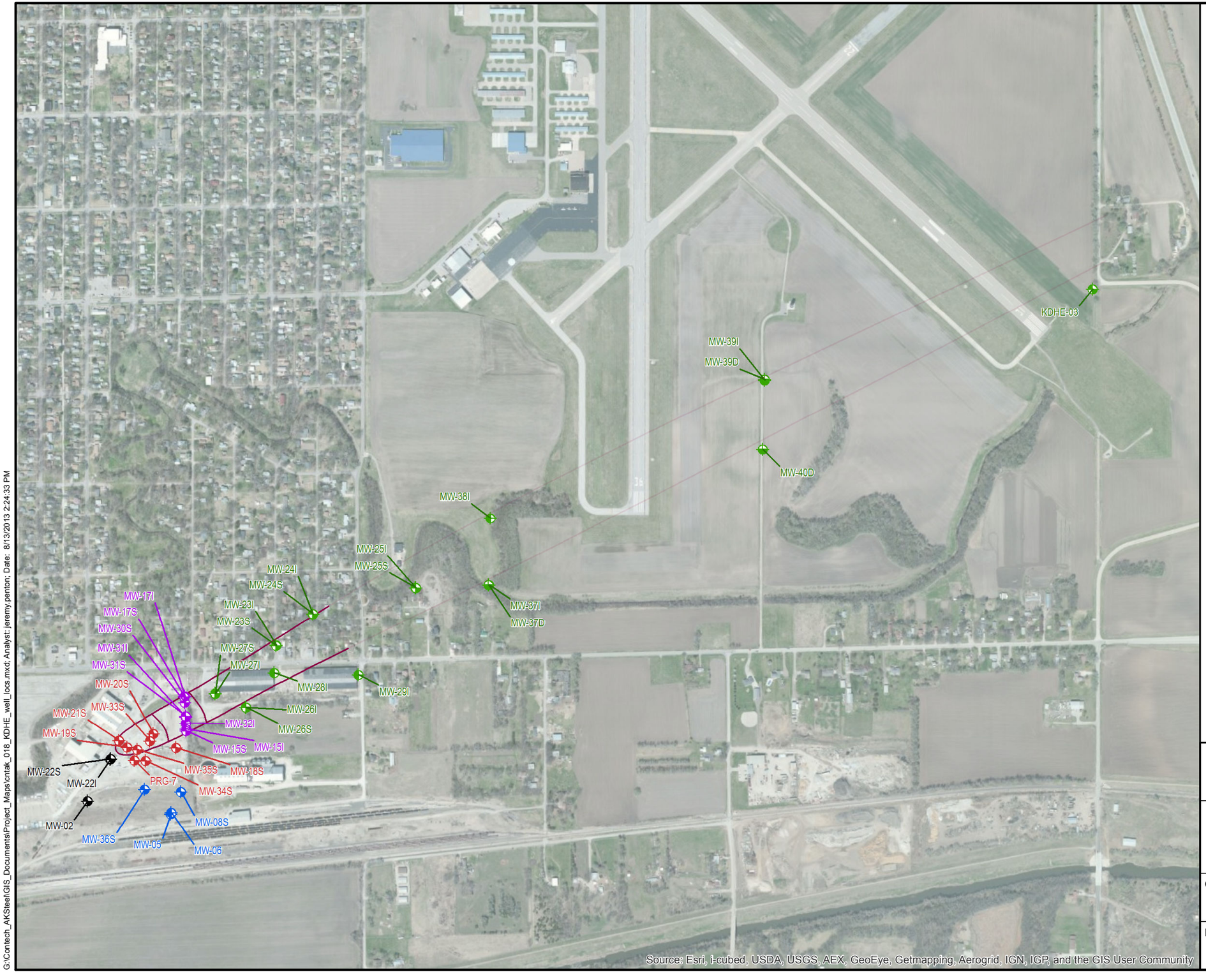

LEGEND

Well Type

- Shallow, Distal Well
- Shallow, Non-Critical Well
- Shallow, Not Sampled
- Shallow, Proximal Well
- Shallow, Source Area Well
- Intermediate, Non-Critical Well
- Intermediate, Proximal Well
- Intermediate, Distal Well
- Intermediate, Not Sampled
- Deep, Distal Well
- Estimated Extent of Groundwater Plume

N

0 700 1,400

Feet

SHAW ENVIRONMENTAL, INC.
(A CB&I COMPANY)
7330 W. 33RD STREET NORTH, SUITE 106
WICHITA, KANSAS 67205
(316) 220-8020

MONITORING WELL LOCATIONS

CLIENT:
CONTECH - AK STEEL

LOCATION:
TOPEKA, KANSAS

FIGURE:
5

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MW-17S Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	5.8
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	0.53
Vinyl chloride	(ug/l)	<1

MW-17I Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	1.9
Tetrachloroethene	(ug/l)	1.4
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	2.6
Vinyl chloride	(ug/l)	<1

MW-20S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	1.1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	130
Tetrachloroethene	(ug/l)	0.9
trans-1,2-Dichloroethene	(ug/l)	7.2
Trichloroethene	(ug/l)	90
Vinyl chloride	(ug/l)	1.6

MW-31I Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	92
Tetrachloroethene	(ug/l)	1.1
trans-1,2-Dichloroethene	(ug/l)	5.2
Trichloroethene	(ug/l)	56
Vinyl chloride	(ug/l)	0.97

MW-30S Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	5.4
cis-1,2-Dichloroethene	(ug/l)	37
Tetrachloroethene	(ug/l)	11
trans-1,2-Dichloroethene	(ug/l)	2.2
Trichloroethene	(ug/l)	60
Vinyl chloride	(ug/l)	<1

MW-26I Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	50
Tetrachloroethene	(ug/l)	0.53
trans-1,2-Dichloroethene	(ug/l)	2
Trichloroethene	(ug/l)	62
Vinyl chloride	(ug/l)	<1

MW-35S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	170
Tetrachloroethene	(ug/l)	1.6
trans-1,2-Dichloroethene	(ug/l)	5.4
Trichloroethene	(ug/l)	69
Vinyl chloride	(ug/l)	<1

MW-33S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	2.8
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	1300
Tetrachloroethene	(ug/l)	16
trans-1,2-Dichloroethene	(ug/l)	43
Trichloroethene	(ug/l)	750
Vinyl chloride	(ug/l)	9.1

MW-32I Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	220
Tetrachloroethene	(ug/l)	2.7
trans-1,2-Dichloroethene	(ug/l)	9.2
Trichloroethene	(ug/l)	130
Vinyl chloride	(ug/l)	0.83

MW-31S Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	38
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	0.87
Vinyl chloride	(ug/l)	<1

MW-26S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	1.7
Tetrachloroethene	(ug/l)	0.64
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	7.1
Vinyl chloride	(ug/l)	<1

MW-21S Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	1.2
Tetrachloroethene	(ug/l)	0.84
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	0.62
Vinyl chloride	(ug/l)	<1

MW-15I Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-27I Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	5.3
Tetrachloroethene	(ug/l)	5
trans-1,2-Dichloroethene	(ug/l)	0.45
Trichloroethene	(ug/l)	7.6
Vinyl chloride	(ug/l)	<1

MW-19S Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	1300
Tetrachloroethene	(ug/l)	15
trans-1,2-Dichloroethene	(ug/l)	82
Trichloroethene	(ug/l)	450
Vinyl chloride	(ug/l)	<1

MW-18S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-15S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	3.2
trans-1,2-Dichloroethene	(ug/l)	9.6
Trichloroethene	(ug/l)	250
Vinyl chloride	(ug/l)	0.55

MW-27S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

PRG-7 Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-34S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-08S Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-36S Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-06 Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-05 Constituent	Units	04/23/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	5.9
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-02 MW-22S MW-22I MW-19S MW-21S MW-35S MW-20S MW-33S MW-17S MW-17I MW-30S MW-31S MW-31I MW-32I MW-15I MW-15S MW-18S MW-27I MW-27S MW-26I MW-26S MW-08S MW-36S PRG-7 MW-34S MW-06 MW-05

Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

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LEGEND

Well Type

- Shallow, Distal Well
- Shallow, Non-Critical Well
- Shallow, Not Sampled
- Shallow, Proximal Well
- Shallow, Source Area Well
- Intermediate, Non-Critical Well
- Intermediate, Proximal Well
- Intermediate, Distal Well
- Intermediate, Not Sampled
- Deep, Distal Well

250 Above RSK

ug/L Micrograms per Liter

Note: Constituents of Concern RSK

1,1-DICHLOROETHENE - 7.0 ug/L
1,2,4-TRIMETHYLBENZENE - 5.0 ug/L
ACETONE - 260 ug/L
CIS-1,2-DICHLOROETHENE - 70 ug/L
TRANS-1,2-DICHLOROETHENE - 100 ug/L
TETRACHLOROETHENE - 5.0 ug/L
TRICHLOROETHENE - 5.0 ug/L
VINYL CHLORIDE - 2.0 ug/L

RSK = RISK-BASED STANDARD KANSAS

N

0 100 200

Feet

SHAW ENVIRONMENTAL, INC.
(A CB&I COMPANY)
7330 W. 33RD STREET NORTH, SUITE 106
WICHITA, KANSAS 67205
(316) 220-8020

GROUNDWATER SOURCE AREA COC CONCENTRATION APRIL 2013

CLIENT: CONTECH - AK STEEL

LOCATION: TOPEKA, KANSAS

FIGURE: 6

MW-27S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-25I Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	0.76
Tetrachloroethene	(ug/l)	5.6
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	2.2
Vinyl chloride	(ug/l)	<1

MW-25S Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	0.62
Tetrachloroethene	(ug/l)	3.8
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	2.9
Vinyl chloride	(ug/l)	<1

MW-38I Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	6.6
Tetrachloroethene	(ug/l)	0.81
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	1.8
Vinyl chloride	(ug/l)	<1

MW-39I Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	1.9
Tetrachloroethene	(ug/l)	0.72
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	0.91
Vinyl chloride	(ug/l)	<1

KDHE-03 Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	9.1
Tetrachloroethene	(ug/l)	4.3
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	5.2
Vinyl chloride	(ug/l)	<1

KDHE-03

MW-27I Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	5.3
Tetrachloroethene	(ug/l)	5
trans-1,2-Dichloroethene	(ug/l)	0.45
Trichloroethene	(ug/l)	7.6
Vinyl chloride	(ug/l)	<1

MW-28I Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
1,2,4-Trimethylbenzene	(ug/l)	<1
Acetone	(ug/l)	<2
cis-1,2-Dichloroethene	(ug/l)	5.6
Tetrachloroethene	(ug/l)	12
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	5
Vinyl chloride	(ug/l)	<1

MW-23I Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	0.81
Tetrachloroethene	(ug/l)	0.8
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	1
Vinyl chloride	(ug/l)	<1

MW-39I
MW-39D

MW-39D Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	2.3
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	0.73
Vinyl chloride	(ug/l)	<1

MW-40D

MW-37I Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	11
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-40D Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	18
Tetrachloroethene	(ug/l)	0.82
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	5.5
Vinyl chloride	(ug/l)	<1

MW-38I

MW-37I
MW-37D

MW-37D Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	0.36
Vinyl chloride	(ug/l)	<1

MW-25I
MW-25S

MW-24S Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-24I
MW-24S

MW-23I
MW-23S

MW-28I

MW-29I

MW-27I
MW-27S

MW-26I
MW-26S

MW-24I Constituent	Units	04/25/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	3.9
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	1.2
Vinyl chloride	(ug/l)	<1

MW-29I Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	0.63
Vinyl chloride	(ug/l)	<1

MW-23S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	<1
Tetrachloroethene	(ug/l)	<1
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	<1
Vinyl chloride	(ug/l)	<1

MW-26I Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	50
Tetrachloroethene	(ug/l)	0.53
trans-1,2-Dichloroethene	(ug/l)	2
Trichloroethene	(ug/l)	62
Vinyl chloride	(ug/l)	<1

MW-26S Constituent	Units	04/24/13
1,1-Dichloroethene	(ug/l)	<1
cis-1,2-Dichloroethene	(ug/l)	1.7
Tetrachloroethene	(ug/l)	0.64
trans-1,2-Dichloroethene	(ug/l)	<1
Trichloroethene	(ug/l)	7.1
Vinyl chloride	(ug/l)	<1

Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

LEGEND

Well Type

- Shallow, Distal Well
- Shallow, Non-Critical Well
- Shallow, Not Sampled
- Shallow, Proximal Well
- Shallow, Source Area Well
- Intermediate, Non-Critical Well
- Intermediate, Proximal Well
- Intermediate, Distal Well
- Intermediate, Not Sampled
- Deep, Distal Well

250 Above RSK

ug/L Micrograms per Liter

Note: Constituents of Concern RSK

1,1-DICHLOROETHENE - 7.0 ug/L
1,2,4-TRIMETHYLBENZENE - 5.0 ug/L
ACETONE - 260 ug/L
CIS-1,2-DICHLOROETHENE - 70 ug/L
TRANS-1,2-DICHLOROETHENE - 100 ug/L
TETRACHLOROETHENE - 5.0 ug/L
TRICHLOROETHENE - 5.0 ug/L
VINYL CHLORIDE - 2.0 ug/L

RSK = RISK-BASED STANDARD KANSAS

N

0 600 1,200

Feet

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GROUNDWATER OFFSITE COC CONCENTRATION APRIL 2013

CLIENT: CONTECH - AK STEEL

LOCATION: TOPEKA, KANSAS

FIGURE: 7

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LEGEND

- Deep SVE Well
- Intermediate SVE Well
- Shallow SVE Well
- Deep Vapor Extraction Well
- SVE Building
- Former Reid Lagoon (Removed 9/2008)
- SVE Piping

N

0 30 60

Feet

SHAW ENVIRONMENTAL, INC.
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ALTERNATIVE 2
SVE & SOIL EXCAVATION

CLIENT:
CONTECH - AK STEEL

LOCATION:
TOPEKA, KANSAS

FIGURE:
8

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LEGEND

Well Type

- Shallow, Distal Well
- Shallow, Non-Critical Well
- Shallow, Not Sampled
- Shallow, Proximal Well
- Shallow, Source Area Well
- Intermediate, Non-Critical Well
- Intermediate, Proximal Well
- Intermediate, Distal Well
- Intermediate, Not Sampled
- Deep, Distal Well
- Treatment Area

N

0 100 200

Feet

SHAW ENVIRONMENTAL, INC.
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ALTERNATIVE 4
FORMER REID BUILDING
SOURCE AREA GROUNDWATER
ENHANCED BIOREMEDIATION

CLIENT:
CONTECH - AK STEEL

LOCATION:
TOPEKA, KANSAS

FIGURE:
9

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LEGEND

Well Type

- Shallow, Distal Well
- Shallow, Non-Critical Well
- Shallow, Not Sampled
- Shallow, Proximal Well
- Shallow, Source Area Well
- Intermediate, Non-Critical Well
- Intermediate, Proximal Well
- Intermediate, Distal Well
- Intermediate, Not Sampled
- Deep, Distal Well
- Treatment Area

N

0 100 200

Feet

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(316) 220-8020

ALTERNATIVE 6
NON-SOURCE AREA GROUNDWATER ENHANCED BIOREMEDIATION AND LONG TERM MONITORING OPTIMIZATION

CLIENT:
CONTECH - AK STEEL

LOCATION:
TOPEKA, KANSAS

FIGURE:
10

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